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**A Review of the Massasaugas, *Sistrurus catenatus*,  
of the Southwestern United States  
(Serpentes: Crotalidae)**

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*The Chicago Academy of Sciences*



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# Bulletin of the Chicago Academy of Sciences

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## A Review of the *Massasaugas*, *Sistrurus catenatus*, of the Southwestern United States (Serpentes: Crotalidae)

Howard K. Gloyd

*The Chicago Academy of Sciences*

Until recent years the massasauga, *Sistrurus catenatus*, a small rattlesnake, was known to occur in Arizona solely on the basis of two poorly preserved specimens in the U. S. National Museum : one from "Southern Arizona" collected by H. W. Henshaw in 1874 and one from the parade ground of Fort Huachuca collected by Dr. T. E. Wilcox about 1890. Four additional specimens from Arizona are now available : one collected in Graham County by D. B. Carver of Scottsdale, Arizona, who presented it to the Chicago Academy of Sciences ; and three from Cochise County, two collected by William H. Woodin of Tucson, and one by Charles M. Bogert of the American Museum of Natural History, New York. All four were obtained by "road collecting" and only one was taken alive and uninjured (Woodin, 1953, p. 294). This new material has provided a stimulus for a re-examination of the distribution and variation of the species in the southwestern portion of its range.

It is now evident that the species *S. catenatus*, occupying a range extending from southeastern Arizona northeastward to northwestern Ontario and central New York, is composed of three recognizable subspecies : *catenatus* in the east, *tergeminus* in the central portion of the range, and another in the southwest for which the name *edwardsi* Baird and Girard, 1853, is here being revived.

Some new material representing *S. c. tergeminus* has also come to hand in recent years. From these specimens data have been added to those available from previous studies and this subspecies is redefined in this paper. The eastern subspecies, *S. c. catenatus*, has not been restudied. Comparative data used here have been taken directly from my earlier paper on the rattlesnakes ( 1940, p. 44 *et seq.*).

## *Sistrurus catenatus edwardsi* (Baird and Girard)

Edwards' Massasauga

1853. *Crotalophorus Edwardsii* BAIRD AND GIRARD, Cat. N. Amer. Rept., pt. I, Serpents, p. 15.
1863. *Crotalus miliarius* var. *Edwardsii* JAN, Elenco sist. degli Ofidi, p. 124.
1874. *Crotalus miliarius* JAN, Icon. Gen. Ophid., liv. 46, pl. 3, fig. 4, 6.
1892. *Crotalophorus catenatus edwardsii* COPE, Proc. U. S. Nat. Mus., vol. 14, p. 685.—*Sistrurus catenatus edwardsii* STEJNEGER, Ann. Rep. U. S. Nat. Mus., (1893) 1895, P. 416, pl. 6.—COPE, Ann. Rep. U. S. Nat. Mus., (1898) 1900, p. 1144.—STEJNEGER AND BARBOUR, Check List N. Amer. Amph. Rept., ed. I, 1917, p. 107 (part); ed. 5, 1943, p. 183 (part).
1936. *Sistrurus catenatus tergeminus* KLAUBER, OCC. Papers San Diego Soc. Nat. Hist., no. 1, p. 6 (part); Trans. San Diego Soc. Nat. Hist., vol. 8, 1936, p. 193 and 229 (part), fig. 20 and 73 (part).—GLOYD, Chicago Acad. Sci., Sp. Publ. no. 4, 1940, p. 36 (part).—SCHMIDT AND DAVIS, Field Book Snakes U. S. and Canada, 1941, p. 287 (part).—SMITH AND TAYLOR, Bull. U. S. Nat. Mus., no. 187, 1945, P. 199 (part).—BROWN, B. C., Check List Rept. Amph. Texas, 1950, p. 222 (part).—WOODIN, Bull. Chicago Acad. Sci., vol. 9, 1953, p. 294.—SCHMIDT, Check List N. Amer. Amph. Rept., 1953, P. 226 (part).

*Type Specimens.* Three specimens, all of indefinite locality, formed the basis of Baird and Girard's original description of *edwardsi*. Attempts to fix the identity and present location of these types led through an investigation of historical and taxonomic literature, through some hundred-year-old records and collections of museums, and into some interesting correspondence. At the risk of being accused of becoming unduly enchanted by musty archives, I think that the results of this search, although incomplete, are worth recording here.

The localities and collectors of the three specimens were listed by Baird and Girard (1853, p. 15) as follows:

Tamaulipas	Dr. [L. A.] Edwards
S. Bank of Rio Grande	Gen. [S.] Churchill
Sonora	Col. J. D. Graham

As Stejneger has explained (1940, p. 204), the reptiles in the collection of the Smithsonian Institution were not given catalog numbers until 1856. Stejneger continued (*loc. cit.*) : "In this register, in Girard's handwriting on January 26, 1858, under numbers 505 to 509 are five specimens entered as follows :

"505 [Crotalophorus] Edwardsii Brazos River, Tex.	Dr. Shumard
"506	Sonora
"507	Tamaulipas
"508	Texas
"509	Mexico
	Dr. Edwards."

According to Stejneger (1895, footnote, p. 417), the three types were numbered 506, 507, and 508. Of these, number 507, Tamaulipas, as "the specimen whose measurements are first given, unless stated to the contrary, has served as the type of the description" (Baird and Girard, op. cit., p. viii), is the holotype and numbers 506 and 508 are paratypes, if Genl. Churchill's "Texas" specimen is indeed the same as the one Baird and Girard listed from "S. Bank of Rio Grande."

The first published catalog number referring to any of these specimens appears to be in Baird's "Reptiles of the Boundary" (1859, p. 15) in which one, and only one, is mentioned: "No. 506. Sonora. J. H. Clark." A snake of this species is figured in Plate 5 of this work but neither number nor locality is associated with it. Cope (1900, p. 1146) listed 506 "Sonora, Texas, Col. J. D. Graham, U.S.A." and 509 "Mexico, Dr. L. A. Edwards, U.S.A. Alcoholic *type*" [italics mine].

When I first examined type specimens of rattlesnakes in the U. S.

National Museum in 1932, number 506 (Sonora) was available but numbers 507 (Tamaulipas) and 508 (S. Bank of Rio Grande or "Texas") were not to be found.\* Comparison of USNM 509, "Mexico, Dr. Edwards," with the original description showed a resemblance that to me at the time seemed beyond a matter of reasonable chance. For example, my count of ventrals (142) differed by only one from that stated by Baird and Girard (143); my count of caudals (28 entire, distal 2 divided) corresponded with theirs (28) if the divided caudals were not included; and my measurements (total length 435 mm.—B & G 17½ inches; tail length, exclusive of rattle, 49 mm.—B & G 2 1/8 inches, possibly including rattle) were closely similar. On the basis of these and other morphological considerations, on Cope's listing of this specimen as "type," and in the absence of any other *Sistrurus* specifically labeled Tamaulipas in the National Museum, I felt justified in assuming that there had been an error in cataloging and that the specimen listed as "Mexico, Dr. Edwards," number 509, was indeed the holotype, and so stated (1940, p. 36). In the light of recently found evidence, previously overlooked, this assumption was in error.

In Jan's "Elenco Sistematico Degli Ofidi," 1863, page 124, under *C. miliaris*, appears the following: "\* var. *Edwardsii* Baird e Gir. Cat.

Stejneger's printed statement (1940, p. 204) that the specimen from Tamaulipas "... number 507, which it still bears on the shelves of the National Museum" was undoubtedly a lapsus, for he had just previously written me (May 23, 1940) that "No specimen labeled Tamaulipas is on our shelves or has apparently been there for over 50 years."

of N. Amer. Rept. p. 15. ( M. Washington) Pamanlipas [sic], Messico." A prefatory note states that the asterisk denotes a specimen in the Museo Civico di Milano (of which Jan was then director). The parenthetic "M. Washington" presumably indicates the source of the specimen.

In Jan and Sordelli, "Iconographie General des Ophidiens," livre 46, 1874, pl. 3, is figured (4 and 6) a specimen which is listed as follows : "C. *miliarius* (Crot. *Edwardsii* Baird & Girard). Tamaulipas, Mexique. Musée de Milan." The figures clearly show that the specimen represents the species *catenatus* (not *miliarius* Linné) and the color pattern depicted for the head and body, including the ventral surface, seem within the known variation of *edwardsi*. The line drawing of a lateral view of the body, however, shows twelve and a half rows of scales which, if accurate, would indicate a total number of 25, instead of 23.

Dr. Doris M. Cochran has kindly checked the files of the U. S. National Museum for correspondence between Jan and Baird. She found no copies of anything written by Baird to Jan, but discovered a letter from Georges Jan, dated November 18, 1855, asking Baird for an exchange of reptiles and listing species desired. In this list is the name *Crotalophorus miliarius*.

It thus appears that the Tamaulipas specimen, the holotype of *edwardsi*, was among those distributed to other museums by the Smithsonian Institution in accordance with a policy stated in the Report of the Secretary for 1860 p. 44-45, 1861) and that it was sent to the Milan Museum sometime between 1858 and 1863.\* In reply to my inquiry, Dr. Giuseppe Scortecci, formerly of the Milan Museum but now Director of the Istituto di Zoologia, Genova, in a letter dated July 18, 1955, stated that he remembered the specimen, "but it was lost as [was] all the herpetological collection during the war."

No evidence of the location or fate of paratype number 508, "S. Bank of Rio Grande" or "Texas," has been uncovered.

The other paratype, number 506, "Sonora," is still in the collection of the U. S. National Museum. Stejneger (1940, p. 204-205) has corrected my assumption (1940, p. 41) that a parchment tag attached to this specimen refers to the town of Sonora, Sutton County, Texas. He emphasized the fact that another parchment tag bearing the following : "Sonora 145: 26 : 23 8½ : 1 1/8" is the *original* label and that the second tag, inscribed "506 Sonora Tex Dr. Graham," was an inadvertency in cataloging. It is likely that I was again influenced by Cope

\* A similar case has been described by Blanchard (1942, p. 66).

who listed the locality of this specimen as "Sonora, Texas" (1900, p. 1146).

*Diagnosis.* A small, slender, generally pale rattlesnake with a nearly white, sometimes immaculate, ventral surface ; distinguishable from its nearest ally, *tergeminus*, by its pale coloration, 23 scale rows at mid-body, lower number of ventrals (males av. 143 ; females, 145), and lower number of dorsal blotches on body (males av. 35 ; females, 37), Table 1.

**Table I. Summary of Diagnostic Characters of the Subspecies of *S. catenatus*.**

	Scale Rows	Ventrals	Caudals	Tail/Total-Length Ratio
<i>edwardsi</i>	23-23-17	♂ 137-148 (143) ♀ 138-152 (145)	♂ 28-36 (32) ♀ 24-29 (26)	♂ .104-.113 (.107) ♀ .088-.095 (.092)
<i>tergeminus</i>	25-25-19	♂ 138-154 (147) ♀ 146-160 (152)	♂ 27-34 (31) ♀ 21-28 (25)	♂ .097-.125 (.112) ♀ .070-.098 (.085)
<i>catenatus</i> *	27(25)-25-19	♂ 129-150 (137) ♀ 136-151 (142)	♂ 24-33 (28) ♀ 20-29 (23)	♂ .089-.119 (.105) ♀ .070-.098 (.084)
	Dorsal Blotches on Body	Tail Bands	Ventral Surface	
<i>edwardsi</i>	♂ 27-41 (35) ♀ 31-40 (37)	♂ 6-10 (8) ♀ 4-8 (6.5)	White or cream, immaculate or sparsely flecked with gray or brown	
<i>tergeminus</i>	♂ 33-46 (39) ♀ 34-49 (41)	♂ 6-11 (8) ♀ 4-8 (6)	White or cream, moderately blotched laterally with brown or gray	
<i>catenatus</i> *	♂ 21-40 (32) ♀ 24-39 (33)	♂ 5-9 (6) ♀ 3-8 (5)	Heavily blotched with gray or black, or nearly all black	

\* Data from Gloyd, 1940, p. 34-35.

*Scutellation.* The following summary of scale characters is based upon a study of 19 specimens, three of which are poorly preserved or fragmentary and do not supply data on all significant details.

Dorsal scale rows usually 23-23-17 ; all 23 at midbody except one which was recorded as 22-22-19-17, and another as 23-25-23-19 ; the minimum in six is 19, and in two 18. Lower lateral two rows without keels ; in subadult specimens keels on third rows are only faintly visible.

Ventrals 137-152 (8 males 137-148, av. 143 ; 8 females 138-152, av. 145). Caudals 24-36 (9 males 28-36, av. 32 ; 8 females 24-29, av. 26) ; from 0 to 7 distal caudals divided (males 0-5, females 0-7).

Dorsal head plates normal for genus. In two instances the prefrontals and internasals are recurved at the lateral margins ; in one there is a small azygous scale between the median posterior margins of the prefrontals, and the frontal is irregularly incised and wrinkled laterally; in three others irregular small scales occur at the anterior or lateral margins of the frontal.

Preoculars 2 on each side, the upper usually in contact with the postnasal, the lower separated from the postnasal by a single subtriangular loreal.

In some specimens the loreals are relatively large and high, noticeably reducing the postnasal-upper preocular contact. In three (USNM 22136, N. M.; Woodin 825 and 1176, Ariz.) the loreals are subrectangular, higher than wide, and completely separate the postnasals from the upper preoculars. In one (CA 12996, Ariz.) this condition occurs on the left side only. Another (USNM 17789, Ariz.) has two loreals, about equal in size, on each side, the upper separating the post-nasals from the upper preoculars. In another (USNM 5177b) the right loreal is divided horizontally, but the upper preocular passes above it to contact with the postnasal.

Lower preoculars divided vertically in three cases. Postoculars ( exclusive of lacrimal) usually 4, occasionally 3 or 5.

Supralabials 10-13, usually 11 or 12 (percentages: 10-2.5 ; 11-50 ; 12-45 ; 13-2.5). Infralabials 10-13, usually 11 or 12, but frequently 13 ( percentages : 10-5 ; 11-30 ; 12-37.5 ; 13-27.5 ) .

*Form and Size.* Available material does not permit a satisfactory analysis of body proportions. The tail/total-length ratio in 7 presumably adult specimens (over 300 mm. long) varies from .088 to .113 (4 males .104-.113, av. .107 ; 4 females .088-.095, av. .092).

The largest specimen examined, a male (AMNH 70719, Cochise Co., Ariz.), measured 530 mm. in total length ; the largest female (USNM 19299, indefinite locality), 498 mm.

*Coloration.* Dorsal ground color pale brown. A single middorsal series of medium to dark brown blotches, 27 to 41 in number (9 males 27-41, ay. 35 ; 8 females 31-40, ay. 37), subcircular, subovate or sub-elliptical in shape, each narrowly bordered with blackish brown and irregularly edged with brownish white. Three alternating series of lateral spots, the median more conspicuous than the others, the uppermost paler and less defined, the lowermost diffuse and becoming obsolescent posteriorly. Tail with 4 to 10 brown crossbands (9 males 6-10, av. 8 ; 7 females 4-8, av. 6.5). Ventral surface white or cream, immaculate



or sparsely blotched laterally with light gray or brown which in larger specimens tends to be diffused.

Internasals and prefrontals brown ; a pair of brown stripes extend backward from the posterolateral edges of the supraoculars to the neck region, forming a more or less symmetrical, lyriform figure, sometimes with incised margins, the anterior ends not meeting in a transverse bar across the frontal\*; a pair of brown spots on the supraoculars and frontal, and a single median brown spot on the parietals. A diagonal white line from the postnasal to the angle of the mouth ; above this a broad brown stripe, two or two and one-half scales wide, extending diagonally backward to the side of the neck. Upper and lower labial region anteriorly stippled or blotched with brown or gray. Mental and chin shields pale brown or white, sometimes immaculate.

*Distribution.* Cochise and Graham Counties, Arizona, central New Mexico, Trans-Pecos Texas, and the Valley of the Rio Grande south to the Brownsville region ; possibly adjacent Mexico (Fig. 1).

The only records of this rattlesnake south of the present international boundary known to me are those of the original types of Baird and Girard, and of these the one labeled "Sonora" could have been collected in what is now southern Arizona or southern New Mexico, for in 1851, before the Gadsden Purchase, this region was within the Mexican state of Sonora, as Stejneger has already pointed out (1940, p. 204).

This is apparently a desert-grassland race which may well inhabit territory farther to the north and east than present knowledge indicates. A specimen in the collection of the Academy of Sciences of Philadelphia (10740) with the indefinite locality "Tule Canyon, Staked Plain" has 23 scale rows and may either represent this subspecies or be regarded as an intergrade with *tergeminus*. Another (ANSP 7235), one of Cope's specimens, labeled "Miami and Mobeetie" (in Roberts and Wheeler Counties, respectively, in the northeastern Panhandle of Texas) has 25 scale rows and is otherwise fairly typical of *tergeminus*, except for its pale coloration and nearly immaculate belly.

\* In the specimens at hand this lyriform figure is not as distinct or as symmetrical as is typical for *S. c. tergeminus* (Evans and Gloyd, 1948, p. 225, pl. I, fig. 1).

**Material Examined**

ARIZONA: *Cochise* Co.—Fort Huachuca, USNM 17789; 2 mi. n.e. Chiricahua, AMNH 70719 ; 4.4 mi. n. Douglas, WOODIN 825 ; 10.5 n.n.w. Douglas, WOODIN 1176. *Graham* Co.—21 mi. e. Safford, CA 12996. No definite locality, USNM 8409.

COLORADO: No definite locality, CNHM 2468.

NEW MEXICO: *Dona Ana* Co.—Las Cruces, USNM 22136; Jornada Range Reserve (25 mi. n. Las Cruces), UCLA 4. *Guadalupe* Co.—2 mi. e. Vaughn, CORNELL 827. *Lincoln* Co.—Corizozo, UMMZ 67669. *Valencia* Co.—Belen, CARNEGIE 2132.

TEXAS: *Cameron* Co.—Brownsville, USNM 511; Santa Rosa,\* USNM 32738. *Jim Hogg* Co.—20 mi. s. Hebbronville, CA 6955. *Pecos* Co.—Ft. Stockton, USNM 5177 a, b.

Indefinite localities: "Texas ?," USNM 19299.t "Sonora," USNM 506, "Mexico," USNM 509, see remarks under type specimens.

*Affinities.* Although at this point intergradation is assumed rather than demonstrated, there can be little doubt of the close relationship of *edwardsi* to *tergeminus*, a population occupying an adjacent area to the eastward. This relationship is discussed under the latter subspecies.

\* There has been some question as to whether this refers to the Santa Rosa in Cameron Co. or to the one in El Paso Co. Dr. Doris M. Cochran kindly checked for me the original field catalog of the collector, William Lloyd, which for the date on which this specimen was taken, Sept. 30, 1891, definitely says "near Santa Rosa, Cameron Co., Tex."

t This specimen, collected by E. A. Mearns, was probably taken by Dr. Mearns and/or his associates of the Biological Section of the International Boundary Commission of 1892. A notation in the catalog of the U. S. National Museum reads as follows: "Specimens 19281 to 19407 inclusive were found loose in tank, together with fishes, mammals, insects, etc. and every one without a label. Scales etc. mostly rubbed off. L. Stejneger, Oct. 27, '92." According to Mearns' account of his itinerary (1907, p. 8-13), he arrived at El Paso by train on February 1, 1892, and systematically engaged in collecting specimens, on both sides of the boundary, from El Paso westward as far as the vicinity of Bisbee, until October 10 of that year. It thus appears reasonably certain that this rattlesnake (19299) was collected within the present known range of *edwardsi*.

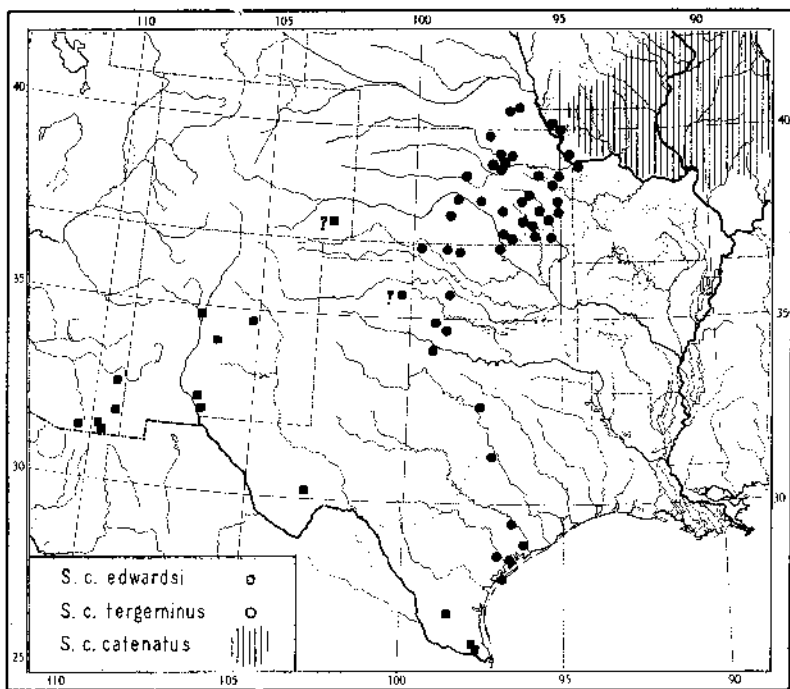


Figure 1. Map showing localities from which specimens of *S. c. edwardsi* and *S. c. tergeminus* have been examined.

*Sistrurus catenatus tergeminus* (Say)

Western Massasauga

1823. *Crotalus tergeminus* SAY, Long's Exped. Rocky Mts., vol. I, p. 499 (Type locality indefinite; no type specimen designated. See discussion in Gloyd, 1940, P. 38.).
1837. *Crotalus miliarius* SCHLEGEL, Essai Phys. Serp., vol. 2, p. 509 (part).
1853. *Crotalophorus consors* BAIRD AND GIRARD, Cat. N. Amer. Rept., pt. I, p. 12 (Type locality Indianola, Texas. Type specimen, USNM 512, lost many years ago, according to Stejneger, 1895, p. 415; not now in U. S. National Museum, according to Dr. Doris M. Cochran in a letter dated July II, 1955.).
1859. *Crotalus miliarius* var. *tergeminus* JAN, Rev. Mag. Zool., ser. 2, vol. 10, p. 153 (part).
1883. *Sistrurus catenatus* var. *consors* GARMAN, Mem. Mus. Comp. Zool., vol. 8, p. 176.-*Sistrurus catenatus consors* STEJNEGER, Ann. Rep. U. S. Nat. Mus., (1893) 1895, P. 415.-BROWN, A. E., Proc. Acad. Nat. Sci. Phila., 1901, p. 99 (part).
1884. *Sistrurus catenatus* CRAGIN, Bull. Washburn Col. Lab. Nat. Hist., vol. 1, p. 103 ; Trans. Kans. Acad. Sci., vol. 9, 1885, p. 138.-BOULENGER, Cat. Snakes Brit. Mus., vol. 3, 1896, p. 570 (part).
1892. *Crotalophorus catenatus edwardsii* COPE, Proc. Acad. Nat. Sci. Phila., P. 337 ; *ibid.*, (1893) 1894, P. 387.-*Sistrurus catenatus edwardsii* STEJNEGER AND BARBOUR, Check List N. Amer. Amph. Rept., ed. I, 1917, p. 107 (part) ; ed. 5, 1943, P. 183 (part).
1901. *Sistrurus catenatus catenatus* BROWN, A. E., Proc. Acad. Nat. Sci. Phila., p. 99 (part).
1936. *Sistrurus catenatus tergeminus* KLAUBER, OCC. Papers San Diego Soc. Nat. Hist., no. 1, p. 6 (part) ; Trans. San Diego Soc. Nat. Hist., vol. 8, 1936, p. 193 and 229 (part), fig. 20, 73 (part), I07.-GLOYD, Chicago Acad. Sci. Sp. Publ. no. 4, 1940, P. 36-44 (part), pl. 2, fig. I, 2.-SCHMIDT AND DAVIS, Field Book Snakes U. S. and Canada, 1941, p. 287 (part).-SMITH AND TAYLOR, Bull. U. S. Nat. Mus., no. 187, 1945, P. 199 (part).-EVANS AND GLOYD, Bull. Chicago Acad. Sci., vol. 8, 1948, p. 226, pl. 1, fig. I.-BROWN, B. C., Check List Rept. Amph. Texas, 1950, p. 222 (part).-SCHMIDT, Check List N. Amer. Amph. Rept., 1953, p. 226 (part).

*Diagnosis.* General coloration darker than that of *edwardsi*, grayish brown or brownish gray ; ventral surface white or cream, more or less blotched laterally with gray or blackish brown, rarely immaculate ; 25 scale rows at midbody ; ventrals 138-160 (males av. 147 ; females, 152) ; dorsal blotches on body 33-49 (males av. 39 ; females, 41), Table I.

*Scutellation.* The following summary is based on the examination of 158 specimens, of which 13 are fragmentary or so poorly preserved that they can not properly be sexed or measured, or are without specific locality, and hence furnish little or no useful data.

Dorsal scale rows usually 25-25-19, the number 25 at midbody appearing in 84.8 per cent of the specimens at hand, 23 in 8.3 per cent, 27 in 6.2 per cent, and 21 in a single instance. The anterior number, counted about one head-length posterior to the head, is 25 in 60.6 per cent, 27 in 34.5 per cent, 23 in 4.2 per cent, and 21 in a single instance. The posterior number, counted immediately in front of the anal plate, varies from 17 to 21 (percentages: 17-4.1 ; 18-3.5 ; 19-78.0 ; 20-10.3 ; 21-4.1). One or two lower lateral rows without keels.

Ventrals 138-160 (64 males 138-154, av. 147 ; 80 females 146-160, av. 152). Caudals 21-34 (65 males 27-34, av. 31; 79 females 21-28, av. 25) ; from 0 to 7 distal caudals divided (males 0-6, females 0-7).

Dorsal head plates normal for genus; relatively few instances of small scales between frontal and supraoculars. In one case a large azygous scale between prefrontals; in two, partial division of the parietals.

Preoculars 2 on each side, the upper usually in broad contact with the postnasal, the lower separated from the postnasal by a single triangular loreal. Loreals one on each side ; in two instances fused, or partly fused, with the postnasal. Lower preoculars rarely divided vertically. Postoculars (exclusive of lacrimal) usually 4, occasionally 3 or 5.

Supralabials 10-14, usually 12 (percentages: 10-3.2; 11-33.1 ; 12-52.2; 13-10.8; 14-0.7). Infralabials 11-15, usually 13 or 12 (percentages : 11-3.5 ; 12-40.1 ; 13-49.5 ; 14-6.7 ; 15-0.2) .

*Form and Size.* In general a more robust snake than *S. c. edwardsi* appears to be, but more slender than *S. c. catenatus*. Tail/total-length ratio in adults (over 400 mm. in total length) .070-.125 (31 males .097-.125, av. .112 ; 49 females .070-.098, av. .085). Young (under 300 mm. in total length) .071-.120 (25 males .093-.120, av. .107 ; 23 females .071-.094, av. .084).

The largest specimen examined, a male collected in Pottawatomie Co., Kans., April 10, 1930, by Hobart M. Smith, measured 820 mm. in total length. It is now represented by a skull in the collection of the Chicago Academy of Sciences. The next largest, also a male, KU 2317, from Swope Park, Kansas City, Mo., is 810 mm. in total length. The largest female, CA 8878, Holt Co., Mo., is 767 mm. in total length.

Seven of a new-born brood of eight from Holt Co., Mo., CA 8657-63, varied in length from 208 to 235 mm. (4 males 220-235, av. 228 ; 3 females 208-225, av. 218). Another group of nine young, thought to be new-horn, CNHM 43585-93, from the China Spring area, McLen-

nan Co., Tex., ranged from 178 to 216 mm. (6 males 178-209, av. 195 ; 3 females 198-216, av. 206).

*Coloration.* Dorsal ground color brown or grayish brown ; the blotches of the middorsal series darker, 33 to 49 in number (64 males 33-46, av. 39 ; 79 females 34-49, av. 41), irregularly rectangular, elliptical, ovate, or circular in shape. Anteriorly some of the blotches are often deeply incised or cordiform, medially they are usually wider than long, and posteriorly tend to become ovate or subcircular. Each has a narrow inner border of brownish black and a narrow, irregular outer border of light gray or white.

Lateral spots in three alternating series, those of the middle row opposite those of the middorsal series and more conspicuous than those of the upper and lower lateral rows.

Tail with 4 to 11 brown crossbands (64 males 6-11, av. 8 ; 78 females 4-8, av. 6).

Ventral surface white, yellowish white, or cream, moderately stippled or blotched with dark brown, gray or black, the blotches tending to be heavier toward the sides of the belly.

Head usually with a conspicuous, symmetrical, lyriiform pattern extending from the supraoculars to the neck region, the anterior ends spreading laterally and not meeting across frontal. A pair of brown spots (sometimes fused) on supraocular-frontal region, and usually a single brown spot in the median parietal region. Pattern of sides of head and labials similar to that of *edwardsi* and *catenatus*.

*Distribution.* Grassland or grassland-deciduous forest transition areas from the Gulf Coast of Texas (north of the Nueces River) northward along the edge of the Edwards Plateau of Texas, through west-central Oklahoma, the eastern half of Kansas, southeastern Nebraska, and northwestern Missouri (Fig. 1) ; intergrading with *S. c. catenatus* in eastern Kansas and north-central Missouri (Evans and Gloyd, 1948) and probably with *S. c. edwardsi* in the Texas Panhandle.

In a few specimens from the extreme western part of the range, 23 scale rows (a character of *edwardsi*) occur, but this number of scale rows is also found occasionally in the eastern part of the range (e.g., Ellsworth Co., Kans., Saline Co., Nebr., and Holt Co., Mo.). Specimens from eastern Kansas show tendencies toward *catenatus* in their darker coloration, but in such characters as number of ventrals and number of dorsal blotches they are not far from the averages for *tergeminus*.

### Material Examined

KANSAS: *Allen Co.*-4 mi. w. Moran, BOYER-HEINZE 3542. *Anderson Co.*-Garnett, KU 19867. *Butler Co.*-Beaumont, Ku 1605. *Chase Co.*- 18 mi. s.w. Emporia, KSTC 2, IO. *Coffey Co.*-3 mi. w. LeRoy, Ku 2318. *Cowley Co.*-Winfield, CA 10471-2, USNM 86472, 89947-9, 90620; 8 mi. n.e. Winfield, UMMZ 75968;

mi. w. Dexter, BOYER-HEINZE 3543; 1 mi. n.e. Otto, TZS 2168. *Dickinson Co.*-Industry, KU 1636. *Ellsworth CO.*-KU 1637, 1638 (2), 1639, LMK 3755; Arcola, CA 4409. *Franklin Co.*-Ottawa, OU 538, UMMZ 79240. *Greenwood CO.*-KU 16535; Fall River, KU 2316 ; 7.5 mi. S.W. Toronto, KU 16291-2; 8 mi. s.w. Toronto, KU 16532-4, 16667-9. *Johnson Co.*-Gardner, PIERCE ( I ) *Labette Co.*-Altamont, CA 4411. *Lyon Co.*-17 mi. s.w. Emporia, KSTC II, 12 ; e. Miller, CA 6173. *Marion Co.*-Peabody, ANSP 17590. *Osage CO.*-KU 2317; Song Creek, Ku 2314; 6 mi. s. Carbondale, KU 17457. *Pottawatomie CO.*-KU 18026; 10 mi. n.e. Manhattan, Ku 17900; 17 mi. n.e. Manhattan, UMMZ 79239 (2), 79241; 9 mi. w. Westmoreland, UMMZ 79238 (8). *Pratt Co.*-Pratt, KU 1606. *Reno Co.*-Medora, UMMZ 79245 (4). *Riley Co.*-Manhattan, KSC 351. *Stafford CO.*-KU 7520, LMK 3754; Little Salt Marsh, Ku 1705; Salt Marsh, UMMZ 79244 (3). *Washington Co.*-Haddam, UMMZ 79242. *Woodson Co.*-Neosho Falls, Ku (1, unnumbered). Indefinite locality: "Kans. ?" USNM 4656.

MISSOURI: *Andrew Co.*-2 mi. w. Fillmore, CA 10843. *Jackson Co.*-Swope Park, Kansas City, Ku 2317. *Holt Co.*-5 mi. s. Mound City, CA 8612, 8657-63, 8691, 8878-80, 8888. *Platte Co.*-Bean Lake, CA 10756, 10844; East Leavenworth, CA 10757.

NEBRASKA: *Lancaster Co.*-Lincoln, NU 98; 10 mi. w. Lincoln, NU 273; 0.5 mi. n. Lincoln, CA 12531. *Saline Co.*-6 mi. n.e. Crete, NU 299. Indefinite locality: NU 306, USNM 514 (3).

OKLAHOMA: *Alfalfa Co.*-4 mi. e. Cherokee, UOMZ 9210. *Comanche Co.* - UOMZ 19665; 8 mi. n. Cache, UOMZ 12656; To mi. n.w. Cache, UOMZ 12996; Wichita Forest Res., uomz 976. *Custer Co.*-Weatherford, UOMZ 3706. *Harper Co.*-6 mi. s.e. Englewood, Kans., UOMZ 19664. *Kay Co.*-14 mi. e. Newkirk, CA 3602, ANDERSON 509. *Kiowa Co.*-io mi. n.w. Meers, UOMZ 13186. *Woods Co.*-Alva, CNHM 629. Indefinite locality: "Verdigris River," USNM 522.

TEXAS: *Aransas Co.*-St. Joseph Island, off Rockport, UMMZ 69706. *Calhoun Co.*-Port Lavaca, ANSP 12096. *Colorado Co.*-Rock Island, KU 1692. *Matagorda Co.*-Demming's Bridge, MCZ 19885. *McLennan Co.*-UMMZ 79243; China Spring, CNHM 46434; 4 mi. n.w. China Spring, CA 13763-71, CNHM 43410-I, 43584-93, TEXAS A & M 1972. *Parker Co.*-5 mi. s.e. Weatherford, CA 16543. *Victoria Co.*-Keeran Ranch, USNM 61589. *Wilbarger Co.*-Vernon, BAYLOR 4687; 5 mi. n. Vernon BAYLOR 4416 ; Waggoner Ranch, BAYLOR 4060-I. Indefinite localities: "Young ? Co.," TEXAS A & M 560; Roberts or Wheeler Co., "Miami and Mobeetie," ANSP 7235; "Tule Canyon, Staked Plain," ASNP 10740.

*Affinities.* In discussing the probable phylogenetic relationships of *tergeminus* and *catenatus* (Gloyd, 1940, p. 55), it was pointed out that *catenatus* now occupies a geographic range entirely within the most recently glaciated region, and must have spread into this area subsequent to the retreat of the glaciers. Here it has acquired a heavy, dark pigmentation and now persists chiefly in humid, swampy areas. Evidence on the basis of structural characters and geographic variation was advanced to indicate that *catenatus* may logically be considered a direct derivative of *tergeminus*, its structural differences being manifest chiefly in a reduction in number of ventrals, caudals, dorsal blotches, tail bands, relative length of tail, and in its darker coloration. Comparison of the variation of such structural characters in *edwardsi* with those of *tergeminus* shows a similar reduction in number of ventrals and number of dorsal blotches, and a less marked reduction in relative length of tail. Furthermore, there is a reduction in number of scale rows and a notable reduction in amount of pigmentation, the latter probably a correlation with greater aridity of habitat. From these considerations it appears logical to assume that *tergeminus* is the oldest population of the three and that *edwardsi* is also a direct derivative from it, having become modified by changes similar to, but not identical with, those manifest in *catenatus*, and having diverged less from the parent stock.

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### Abbreviations Used with Reference to Specimens

- ANDERSON—Paul Anderson, Independence, Mo.  
 AMNH—American Museum of Natural History, New York  
 ANSP—Academy of Natural Sciences, Philadelphia, Pa.  
 BAYLOR—Baylor University, Strecker Museum, Waco, Tex.  
 BOYER-HEINZE—Dorothy Boyer and Albert Heinze, St. Louis, Mo.  
 CA—Chicago Academy of Sciences  
 CARNEGIE—Carnegie Museum, Pittsburgh, Pa.  
 CNHM—Chicago Natural History Museum  
 CORNELL—Cornell University, Ithaca, N. Y.  
 KSC—Kansas State College, Manhattan  
 KSTC—Kansas State Teachers College, Emporia  
 KU—University of Kansas, Museum of Natural History, Lawrence LMK—  
 Laurence M. Klauber, San Diego, Calif.  
 MCZ—Museum of Comparative Zoology, Harvard University, Cambridge, Mass. NU—  
 University of Nebraska, Museum of Natural History, Lincoln OU—  
 Ottawa University, Ottawa, Kans.\*  
 PIERCE—Leo Pierce, Olathe, Kans.  
 TEXAS A & M—Agricultural and Mechanical College of Texas, College Station  
 TZS—Toledo Zoological Society, Toledo, Ohio  
 UCLA—University of California at Los Angeles  
 UMMZ—University of Michigan, Museum of Zoology, Ann Arbor  
 UOMZ—University of Oklahoma, Museum of Zoology, Norman  
 USNM—U. S. National Museum, Washington, D. C.  
 WOODIN—William H. Woodin, Arizona-Sonora Desert Museum, Tucson

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